the silk required by the insect for the formation of its cocoon, are formed the earliest. The *Malpighian* vessels are completed at a later period in these parasites than in the herbivorous larvæ, in which they are well formed almost from the moment of leaving the egg. In conclusion the author states, "that in proportion to the more or less early development of any structure or organ, the function or instinct associated with that organ is more or less early evolved; and that in proportion to the completeness of a tissue, such is the degree of perfection of each special function or instinct in the animal."

Read also a paper by J. O. Westwood, Esq., F.L.S. &c., entitled "Description of *Melittobia Audouinii*, a Bee Parasite." The following are the essential characters of this genus, which belongs to the family *Chalcididæ* and subfamily *Eulophides*.

MELITTOBIA.

Antennæ maris 9-articulatæ; articulo 1mo maximo subtùs ad apicem excavato, articulis 4to 5to et 6to minimis; fœminæ simplices, 8-articulatæ; articulis tribus apicalibus in utroque sexu clavam ovalem formantibus. *Mas* cæcus. *Fœmina* oculis ocellisque instructa. *Alæ* maris abbreviatæ, fœminæ magnitudinis ordinariæ; alæ vena ordinaria *Eulophorum* typicorum instructæ. Tarsi 4-articulati.—*Habitatio* parasitica in nidis apum cæmentariarum.

Notices of this insect (first observed by the late M. Victor Audouin) had been published by Mr. Westwood in his 'Introduction to the Modern Classification of Insects' and in the Journal of Proceedings of the Entomological Society, and it was also considered by Mr. Westwood as identical with the insect described by Mr. Newport in the preceding paper under the name of *Anthophorabia retusa*, although different from the description published of that insect by Mr. Newport in the 'Gardener's Chronicle' in the major part of its characters, some of which, as the possession of a furcate median vein and 5-jointed tarsi, are foreign to the family and subfamily to which it belongs; whilst the asserted possession of stemmatous eyes by the male was regarded as erroneous, there being no instance of such a structure throughout the whole range of winged insects, whilst it is essentially a character of some of the wingless tribes.

Mr. Westwood also exhibited specimens of the larvæ of *Eulophus Nemati*, which are parasites on the *outside* of the body of the larvæ of *Nematus intercus*, but which are nevertheless destitute of hairs on the surface of the body, although the external parasitism of the larvæ of *Monodontomerus* was considered by Mr. Newport as indicated by the hairs on the surface of their bodies.

ZOOLOGICAL SOCIETY.

Nov. 14, 1848.—Wm. Yarrell, Esq., Vice-President, in the Chair.

The following papers were read:—

1. NOTES ON THE ANATOMY OF THE MALE AUROCHS (*Bison europæus*). By PROF. OWEN, F.R.S., F.Z.S. ETC. ETC.

It was with much concern that I received notice at the latter part of September last of the sudden failing of health of the male Aurochs;

the male of the pair munificently presented to the Zoological Society by His Imperial Majesty the Emperor of Russia, at the instance of our distinguished scientific countryman Sir Roderick Impey Murchison, G.C.SS. The animal had refused its food; it was prostrated by impeded and frequent respiration and a general oppressive feverish state, and died about a week after the first attack.

The morbid appearances, on dissection, were simple and conclusive. The whole right lung had been the seat of active inflammation and congestion; most of the air-cells were filled with a bloody serum, which was infiltrated throughout the connecting tissue. A mass of coagulable lymph had been exuded from the whole exterior surface of the organ, cementing its lobes to each other and to the surrounding parts, especially the pericardium. The mucous lining of the bronchial tubes was of a deep livid red colour, and the same evidence of inflammation extended throughout the trachea, and a little way down the bronchi of the sound lung. Both the liver and spleen broke down more easily under pressure than in the healthy common Ox; the texture of the kidney also was softer, and of a more fuscous colour. The vessels of the pia mater were unusually gorged; but these were probably the secondary consequences of the influence upon the circulation, and the quality of the blood induced by the primary and active disorganization of the respiratory system. The exciting cause of the disease I take to be the influence of the raw cold and heavy fogs, consequent on the undrained extent of clay-ground in which the menagerie of the Society is placed, and by which it is extensively surrounded. The effects of an atmosphere so loaded on the mucous tract of the respiratory organs to which it is applied, has long been manifested in various species of the exotic animals attempted to be preserved in the Zoological Gardens; and the records of medicine bear testimony to similar ill effects upon those human inhabitants of the Regent's Park, whose habits and strength of constitution do not enable them to control and overcome this pregnant but happily remediable source of ill-health.

The male Aurochs, at the period of its death, was two years and five months old. The following was the state of its dentition:— $i\ 3-3$, $c\ 1-1$, $m\ \frac{5-5}{5-5} = 28$; of which $i\ 1$ was permanent, $i\ 2$, $i\ 3$, and c were deciduous; the molars were $d\ 2$, 3 and 4, $m\ 1$ and 2. I here use the formula explained in my communication to the British Association at Swansea, the notation used conveying in the space of one line the following facts: viz. that the animal had shed and replaced the median incisors of the lower jaw, but retained all the rest of its deciduous dentition, having gained in addition the first and second true molars of the permanent series.

The tongue presented that deep leaden-bluish colour which Gilibert describes*, but is rough, as in the common Ox, and the inner surface of the sides of the mouth is beset with the same kind of papillæ. The scrotum and testes were much smaller than in the young do-

* Gilibert, Indagatores Naturæ in Lituania, *De Bisonte Lituanico*, pp. 30—49; Vilnæ, 1781.

mestic Bull of the same age: the scrotum is rugous, sessile, not pendulous with a constricted neck, as in the *Bos Taurus*.

As in most Ruminants, the principal viscus which presents itself on opening the abdomen, is the capacious paunch covered by the great omental sac: besides the paunch, some of the small intestines appeared in the right iliac and in the pubic regions.

The paunch is firmly supported by its attachments on the dorsal aspect to the crura of the diaphragm and part of the expanded concavity of that muscle. The part of the serous membrane which answers to the aperture or mouth of the great omental sac in Man is attached to the upper and fore-part of the paunch, not to the lower or greater curvature, so that a free fold of the omentum is spread over the paunch between it and the abdominal muscles: the posterior fold of the omentum is attached to the left side or contour of the paunch, whence it is continued upon the fourth cavity, the duodenum and pancreas, and so on to the right crus of the diaphragm, forming one of the strong suspensory ligaments: the left lumbar attachment is continued more immediately from the long intra-abdominal œsophagus and back part of the paunch and reticulum.

The paunch is sub-bifid, or divided into two principal chambers. The villi of its inner surface are intermediate in character between those of the common Ox and those of the American Bison. The villi of the rumen of the Ox are comparatively large, coarse, flattened, but pointed, except near the reticulum, where they assume the form of laminæ with irregular jagged margins. In the American Bison they are longer, and for the most part filiform, and consequently more numerous. In the Aurochs the villi are shorter than in the Bison, and broader, being compressed and clavate, terminating in an even rounded margin: they are smaller and more numerous than in the common Ox. The relative position, size, and mode of intercommunication of the four divisions of the ruminating stomach offer no noticeable differences from that of the common Ox: but the disposition of the lining membrane of the second cavity (reticulum or honeycomb-bag) offers as marked a difference as that noticed on the inner surface of the paunch. In the common Ox the cells of the reticulum are deeper than in any Ruminant excepting the Camel-tribe, and they are of two kinds in respect of their size: the larger cells are disposed between broad parallel septa, and are formed by narrower septa at right angles to these: the smaller cells are subdivisions of the larger or primary cells.

In the Bison only one kind of hexagonal cells can properly be recognized, and their walls are of equal depth as a general rule: the folds developed from the bottom of these cells are much narrower, shorter, and more irregular than those that mark out the secondary cells in the common Ox. The laminæ of the third cavity (*psalterium*) are of two kinds, large and small; the larger kind presenting two sizes which alternate with one another; but between each of the broader or larger kind of laminæ one of the smaller kind intervenes: their surfaces are papillose, but the papillæ are shorter than in the common Ox, which presents a similar arrangement of the laminæ.

A thick epithelium lines the whole of the three cavities above-described, as in other Ruminants. The lining membrane of the fourth or true digesting cavity was rather more vascular than usual: the almost smooth mucous membrane is produced into subparallel oblique folds $1\frac{1}{2}$ inch in breadth at its cardiac half: these subside towards the pyloric half, where the chief object is the valvular protuberance which overhangs the aperture leading into the duodenum. The duodenum bends backwards and turns down abruptly before gaining the left lumbar region; then bends upwards and towards the left side, where it becomes free and carries out a complete investment from the mesentery: in the previous part of its course it is closely attached to the adjoining intestines. The principal mass of the small intestines lies dorsal and sacral of the enormous stomach, disposed in short coils upon the mesentery; they measured 132 feet in length.

The ilium terminates in the cæcum in the right lumbar region. The cæcum is a simple, cylindrical, non-sacculated gut, about twice the diameter of the ilium; it is bent upon the beginning of the colon, to which it is attached.

The colon describes an arch at its commencement, ascending from the right side, and curving over to the left behind the paunch, then winding to the right again, and describing the series of subspiral folds characteristic of this gut in the Ruminants. The rectum descends nearly along the bodies of the lumbar and sacral vertebræ to the anus. The total length of the large intestines was twenty-one feet. The liver was proportionally small, and consisted chiefly of one lobe, as in other Ruminants; not extending into the left epigastrium. There is a small *lobulus Spigelii* on the right and posterior border.

The gall-bladder, large and full, protruded from a fissure in the right side of the liver: its duct receives four or five tributary ducts before it unites with the proper hepatic duct, which brings the bile from the left part of the liver. The *ductus communis choledochus* enters the duodenum where it forms its first bend.

The pancreas lies below the liver, with its larger end across the last dorsal vertebra, and its narrower prolongation accompanying the duodenum; the duct terminates in that intestine about eight inches beyond the biliary inlet. The kidneys consisted each of about twenty distinct lobes or renules. The more compact suprarenal bodies also manifested a subdivided outer surface.

The above portions of the notes of the dissection of the male Aurochs include all that appeared to be in any degree characteristic of the species, or affording any discriminative characters, as compared with its nearest congeners. The thoracic viscera, as far as their morbid condition permitted the comparison, were like those of the common Ox. I do not remember to have been so much impressed in former dissections of Ruminants with the beautiful adaptation of the parts exterior to the large and complex stomach, to its support and the facilitating its movements. Much of what is ordinary inelastic aponeurotic tissue in the abdominal parietes of many

other quadrupeds, *e. g.* the larger Carnivora, is metamorphosed into the yellow elastic tissue—*tissu jaune*—in the Aurochs, as in the common Ox, and in a still greater degree in the Rhinoceros and Elephant. By this change the abdominal muscles are proportionally relieved or aided in the sustentation of the capacious and heavily-laden digestive reservoirs.

In the Aurochs, as in the other Ruminants, the disposition of the omental sac upon the sternal aspect of the paunch, interposed between it and the abdominal walls, makes it perform the office of a serous articular sac, two smooth and lubricated surfaces—the inner ones of the sac—being apposed to each other, and easily and freely gliding on each other; it is like a kind of great 'tunica vaginalis'—facilitating the spiral peristaltic movements of the paunch, and by the layer of fat tending to preserve the warmth of the paunch.

The skeleton of the Aurochs has been well delineated by Bojanus, in connection with an outline of the entire animal, and by Mr. George Landseer separately. The general characters of the framework of this rare species are very accurately rendered in both these figures. The skeleton of the young male Aurochs showed the same characteristic elevation of the spinous processes of the anterior dorsal vertebræ, and the same characteristic number of ribs—fourteen pairs—which are shown in the above-cited figures, and which repeated examination has established as constant peculiarities of the species. With regard to the lengthened spines, I shall only remark on this interesting morphological peculiarity, that it contributes to illustrate the artificial nature of that view of the part commonly called rib, or vertebral rib, as a bone or element of the skeleton, apart from or belonging to a distinct genus from the other vertebral elements. This view originally arose from the contemplation of the proportions of the ribs or pleurapophyses and spinous processes as they exist in Man. A long and slender form is associated with the idea of a rib as an essential character. In the Aurochs we see that the vertebral element called neural spine is longer than the pleurapophysis in the second and third dorsal vertebræ. But it is anchylosed to the other vertebral elements, whilst the pleurapophyses retain their primitive freedom, and the dorsal vertebræ are characterized as 'articulating with the ribs.' This, however, is a periodic, not an essential character. At an early period of life the cervical vertebræ also articulate with ribs, *i. e.* pleurapophyses; but these become broad and remain short, and coalesce with the centrums and diapophyses of their respective vertebræ; and the anthropotomist then calls them 'transverse processes,' and distinguishes them as being perforated, the foramen being the space included between the centrum, the diapophysis, and the pleurapophysis.

Another remark is suggested by the skeleton of the Aurochs, touching the true value of the character of its fourteenth pair of free pleurapophyses. In the genus *Bos* proper there are only thirteen pairs. In the American Bison there are *fifteen* pairs. According to the artificial character in anatomy of the 'dorsal vertebræ,' the above-

cited *Bovidæ* have been supposed to differ actually in the number of their vertebræ, whereas this is absolutely the same in each of them; after the seven cervical vertebræ there are nineteen true vertebræ, *i. e.* nineteen vertebræ between the last cervical and the sacral vertebræ. In the embryos of many Ungulates, rudiments of ribs (pleurapophyses) are found moveably attached to vertebræ, to which they afterwards become anchylosed, and accordingly are called lumbar vertebræ. In the Aurochs these elements retain their freedom and growth in one more vertebra than in the common Ox; in the Bison two more vertebræ have moveable pleurapophyses. Accordingly we find that if the common Ox has but thirteen dorsal vertebræ, it has six lumbar vertebræ; if the Aurochs has fourteen dorsal, it has five lumbar; and if the Bison has fifteen dorsal vertebræ, it has but four lumbar. But the unity of the numerical character of the true vertebræ does not stop here; for when we find, *e. g.* in the Dromedary, the Camel, the Llama, and the Vicugna, only twelve dorsal vertebræ, the typical nineteen is completed by seven lumbar vertebræ; and this number is never surpassed in the Ruminants. Most of the species agree with the common Ox in the number of the true vertebræ that retain their pleurapophyses in moveable connection. The Reindeer and the Giraffe resemble the Aurochs in having fourteen dorsal vertebræ. But what perhaps is still more interesting and usefully instructive as to the true affinities of the hoofed quadrupeds with toes in even number, is the fact, that besides their common possession of a complex stomach and simple cæcum, of a peculiar form of astragalus, of a femur with two trochanters, and of a symmetrical pattern of the grinding surface of the molar teeth, they also agree, as I have shown in my paper on the genus *Hyopotamus*, in having nineteen natural segments of the skeleton, neither more nor less, between the neck and the pelvis. The Babiroussa, the African Wart-hogs (*Phacochærus*), and the extinct *Anoplotherium*, resemble the majority of Ruminants in having thirteen dorsals and six lumbars; the Wild Boar and the Peccari resemble the Aurochs in having fourteen dorsals and five lumbars; the Hippopotamus resembles the Bison in having fifteen dorsals and four lumbars.

This constancy in the number of the true vertebræ in the Artiodactyle Ungulates is the more remarkable, and demonstrative of their natural co-affinity, by contrast with the variable number of those vertebræ in the odd-toed or Perissodactyle group, in which we find twenty-two dorso-lumbar vertebræ in the Rhinoceros, twenty-three in the Tapir and Palæotherium, and as many as twenty-nine in the little Hyrax.

With regard to the vertebræ of the trunk of the Aurochs, I may remark, that the only accessory process in addition to the ordinary zygapophyses and diapophyses is the metapophysis, which appears as a stout tubercle above the diapophysis in the middle dorsals, and gradually advances and rises upon the anterior zygapophyses in the posterior dorsal and lumbar vertebræ. This process is developed to an equality of length with the spinous processes in the Armadillos.

It is commonly associated with another accessory exogenous process, to which I have given the name 'anapophysis' in the Catalogue of the Osteological Series in the Royal College of Surgeons. This process, which in most of the Rodentia rises, at first, in common with the metapophysis, as a tubercle above the diapophysis, separates from the metapophysis as the vertebræ approach the pelvis, and in the lumbar series the anapophysis is seen projecting backwards from the base, or a little above the base of the diapophysis, its office being usually that of underlapping the anterior zygapophysis of the succeeding vertebræ, and strengthening the articulation, whence Cuvier has alluded to it as an accessory articular process; but its relation to the zygapophysial joint is an occasional and not a constant character. The tenth dorsal vertebra of the Saw-toothed Seal, *Stenorhynchus serridens*, affords a good example of well-developed metapophyses; they are also large in most of the trunk vertebræ of the Tapir. The anapophyses are well-developed in the anterior lumbar vertebræ of the Hare and Rabbit.

I have been induced to make this digression at the request of some of my anatomical friends, who have desired me to publish definitions of the terms, or rather of the processes so termed.

Returning to the Aurochs, I shall conclude with some remarks, which the opportunity of dissecting the recent animal enables me to offer, respecting the true structure of the bones of the fore-foot (fig. 1) and hind-foot (fig. 2).

The carpus (fig. 1) consists, as in other Ruminants, of six bones, four in the proximal row, viz. scaphoides (*s*), lunare (*l*), cuneiforme (*c*), pisiforme (*p*); and two in the second row, the magnum (*m*) and the unciforme (*u*).

The os magnum supports that half of the cannon-bone which answers to the metacarpal of the digitus medius (III). The unciforme supports the other moiety which answers to the metacarpus of the digitus annularis (IV). The rudiment of the proximal end of the metacarpus of the digitus index (II) articulates with a part of the os magnum, which may therefore be regarded as a connate trapezoïdes. The rudiment of the proximal end of the metacarpal of the digitus minimus (V) articulates with the cuneiforme, and is applied to the ulnar end of the unciforme.

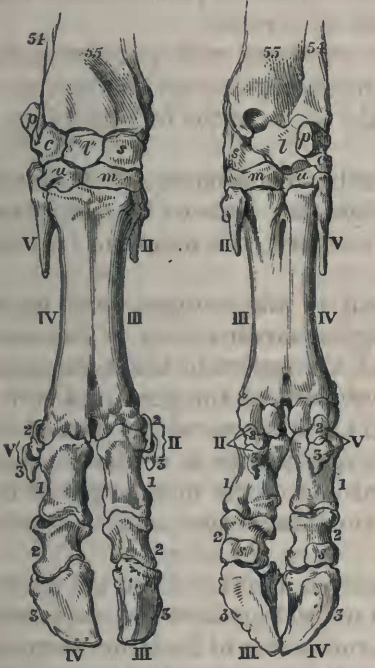
The distal rudiments of the two abortive digits (II) and (V) are represented by a middle phalanx (2) and ungual phalanx (3), supported by fasciæ extending from the proximal rudiments of their metacarpals, and also by ligaments attaching them to the large trochlear sesamoids behind the metacarpo-phalangeal joints of the two normal digits (III and IV). These have each three phalanges (1, 2, 3) forming almost symmetrical pairs, with a large sesamoid (*s*) behind the distal joint.

The hind-feet (fig. 2) are longer and more slender than the fore-feet, the greater length being chiefly due to the coalesced metatarsals.

The tarsus includes five bones; it seems to consist of six, but the ossicle (67) wedged between the tibia (66), calcaneum (*cl*), and astra-

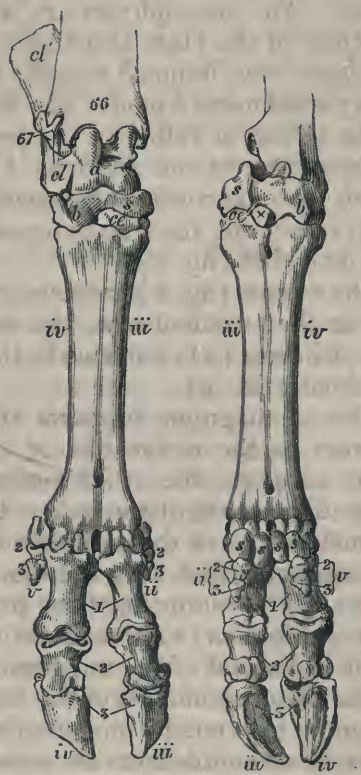
galus (*a*), is the distal epiphysis of the fibula, and the sole representative of that bone. The astragalus and calcaneum conform to the ordinary Ruminant type; according to which, also, the naviculare (*s*) and cuboid (*b*) are confluent. The ectocuneiform (*ce*) is a broad flat bone supporting the moiety of the cannon-bone which answers to the digitus medius (*iii*): a small round sesamoid (*s*) at the back of this joint has not sufficiently distinctive characters to carry conviction as to its special homology. The outer half of the cannon-bone, or metatarsal of the fourth toe (*iv*), articulates with the cuboid part of the scapho-cuboid bone. The second digit (*ii*) and fifth digit (*v*) are represented solely by the rudiments of their middle and ungual phalanges (2 & 3). There are two large trochlear sesamoids (*s*) behind the metatarso-phalangeal joints of the two fully-developed

Fig. 1.



Bones of fore-foot (*Bison europæus*).

Fig. 2.



Bones of hind-foot (*Bison europæus*).

toes (*iii* & *iv*), and one sesamoid behind the last joint of the same toes.

In most artificially-prepared skeletons of Ruminants, more or less of the small bones, often regarded as accessory, are lost; but they are really for the most part beautifully indicative of traces of adherence to the archetype, and I have on that account particularized them in this notice of the anatomy of the Aurochs.

Measurements of the Trunk of the Aurochs.

	Inches.
Length of vertebral column from the atlas to the sixth caudal vertebra, measured across the diapophyses	81
Length of vertebral column over the neural spines	88
Length of cervical region over the diapophyses	17
Length of dorsal region ditto	30
Length of lumbar region ditto	13
Length of sacral and six caudal ditto	21
Depth of spine of seventh cervical	8
Depth of spine of first, second and third dorsal, being the three longest, each	11
Length of first rib	9
Length of ninth, or the longest	18½
Seven ribs articulate by separate hæmapophyses to the sternum.	
Length of diapophysis of fourth lumbar, or the longest	4½
Breadth of atlas across the neural arch	7
Extreme breadth across the spines of the ilia	14
Extreme breadth across the pubis, from the inner edge of each acetabulum	6

MISCELLANEOUS.

On the Velvet-like Periostraca of Trigona. By J. E. Gray, Esq.

In my account of the species of the genus *Trigona* of Megerle, I mentioned that several species were covered with a velvet-like silvery coat hiding the surface of the horny periostraca.

When this coat is minutely examined, it is found to be formed of numerous elongated spicula of a uniform length placed side by side perpendicular to the surface of the periostraca, so as to form a pile like velvet or plush. The length of the spicula, and consequently the thickness of the coat, increases towards the margin of the shell. This coat is generally rubbed off from the more convex part of the specimens which have not been very carefully preserved, but in such examples it is usually to be found near the edge of the valves, or on the lunule and other sunken portions of the surface.

The Rev. Dr. Fleming has lately drawn my attention to the fact, that these spicula are siliceous and similar to those of siliceous sponges; indeed Dr. Fleming is inclined to regard the velvet-like coat as a species of *Halichondria* parasitic on the shell rather than as a portion of the periostraca itself; and Dr. George Johnson of Berwick, who examined Dr. Fleming's specimen with me, is inclined to take the same view of the question.

With these authorities opposed to my view I have reconsidered the question, but I am still inclined to believe that I am correct in considering the spicula as part of the shell formed by the animal as it produces the periostraca on the edge of the shell, and offer the following reasons in support of this conclusion :—

1st. This kind of coat is found on several species of the genus which inhabit different parts of the world.